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# Southwest FISHERIES CENTER

HONOLULU LA JOLLA MONTEREY TIBURON

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# COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

## COASTAL EASTERN PACIFIC POPULATION BIOLOGY OF FISHES

### Meeting Held to Implement Cooperative Agreement on Evaluation of Port Sampling

Under the Cooperative Agreement between the California Department of Fish and Game and the NMFS Southwest Fisheries Center which began June 15, 1987 and will extend to March 31, 1989, both agencies share a concern for the need to obtain sound estimates of species composition and age composition of mackerel and sardines for stock assessment. The State is responsible for collecting catch and other data from California fishers; the SWFC is responsible for evaluating the sampling procedure for collecting mackerel and sardines, which was designed primarily for anchovy.

A meeting was held at the Southwest Fisheries Center in La Jolla on February 23 to discuss the status of the project and to set a time table of activities to be undertaken for the next few months with Patricia Wolf, Supervisory Biologist and leader of the Pelagic Fisheries Project at the California Fish and Game, and Mathematician Dr. Nancy Lo and Statistician Donna Mallicoate of the Southwest Fisheries Center in attendance.

The specific objectives of this project are to evaluate the estimation procedures for age composition and species composition. Under the current sampling criterion a boat is sampled for a species if the species exceeds a certain percent of the catch. At this time for jack mackerel it is greater or equal to 5%; for Pacific mackerel greater or equal to 5%, and for sardine greater or equal to 1%. The structure of the current sampling procedure is that cumulative catch of 5,000 tons constitutes a stratum within which every 40 random samples (each sample of fixed weight) are taken for biological measurements.

Lo started the initial analyses with Mallicoate of the Pacific Fisheries Environmental Group assisting with data assemblage and computing. The following is a summary of progress to date.

Two estimates are available for species composition. One is bucket estimates (BE) by the warden and the other is visual estimates (VE) by the port sampler. The former is a thorough sampling which covers 36% of the boat loads with most of the data recorded on raw data sheets. The latter, a crude eye inspection, covers 75% of the boat loads.

Three questions can be addressed on species composition: 1) how does the VE compare with the BE?; 2) if the VE is as accurate as BE, is it necessary to cover 75% of the boat load?; and 3) what is the precision of these two estimates?

Lo reported that the analysis has been completed to answer the first question; work continues on the process for answering the second question; however, the answer to the third question must await availability of computer data files.

Lo noted that the comparison of VE and BE was made based on 1986 and 1985 data. Little difference was detectable between BE and VE for both Pacific mackerel and jack mackerel. Out of 272 boats which had both VE and BE estimates, about 12% of the boat loads have differences (in percent) greater than 20%. The landing numbers of those boats are available for further data checking. We have concluded that the VE is not worse than BE.

Using the sampling criterion for specific species: For Pacific mackerel and jack mackerel greater than 5% and sardine greater than 1%, we found that certain landings are not sampled for a species because the species is a small portion of the catch. We assembled the landing data to estimate the percentage of the landing contributed by boat loads with various species composition.

In our analysis based on either BE or VE, we reached the same conclusion: the current sample criterion misses less than 1% of Pacific mackerel and jack mackerel. If manpower is a problem and the species composition remains unchanged, the percent for both Pacific mackerel and jack mackerel could be raised from 5% to 10%. In this case at most only 3% of the landings will be excluded. For sardine, 26% of the sardine landings are contributed by boat loads with sardine constituting less than 5% of the catch. None of the boats have loads where sardine constitutes more than 51% of the catch. Thus, the current sampling criterion for sardine should be continued.

Lo indicated that the group intended to address two questions pertaining to age composition: 1) Are current estimates of age composition appropriate under the current sampling scheme and 2) How does the precision of the current estimates compare with other estimates.?

The current estimates of age computation are those of multinomial formula, easy to compute and understand. It is, however, unbiased only if within species--each fish in the total catch of that species has an equal chance of being sampled. Under the current sampling scheme this is true only if the catch consists of a single species. For multiple species catch, the species composition has to remain constant. The 1986 data set reveals a strong correlation between Pacific mackerel and actual total catch, but not so for the other two species. Thus far, the current estimates of age composition for Pacific mackerel may have little bias. A present need is to examine age composition of jack mackerel which was only available for years before 1985 and for this we must await the data set.

Both questions will be answered in detail with a computer simulation model which assumes the sampled boat loads to represent the fishing fleet. Various age composition statistics will be used and compared for accuracy and precision. Besides the current sampling scheme, a random sample of boat loads could be considered which would guarantee an unbiased estimate of age composition for all species with possible larger variance than the current sampling scheme for Pacific mackerel.

Wolf, Lo and Mallicoate plan to meet during the latter part of May to test the simulation model. The analysis should be completed by the end of this year. (N. Lo, FTS 893-7123)

**Preliminary Report on the Physiology of Dover Sole Larvae**

Dover sole (*Microstomus pacificus*) larvae exhibit remarkable changes in morphology and physiology during metamorphosis. Dover sole larvae are non-pigmented and have a rounded leaf-like shape with a large body depth to length ratio. After metamorphosis, the body has a smaller depth to length ratio, is pigmented and has a calcified skeleton. Mary Sue Lowery, a National Research Council postdoctoral fellow at the Southwest Fisheries Center, has begun an investigation of the biochemical changes which occur in the muscle of larval Dover sole during growth and metamorphosis.

Larvae used in this study were captured offshore near the oxygen minimum layer (450-480 m). Metamorphosed individuals were capture inshore at a depth of 32 meters (bottom depth 88 m).

Protein content of the muscle of metamorphosed Dover sole is twice that of the larvae. This increase in protein content is not a simple doubling, but rather a major restructuring of the muscle protein composition.

Muscle proteins were fractionated into a soluble fraction containing enzymes of metabolism, for example, and an insoluble fraction containing structural proteins of the myofibrils and connective tissue. As seen in Figure 1, the soluble proteins comprise 48.1 $\pm$ 3.5% of the total muscle protein, a composition similar to that seen in the white muscle of adult fish.

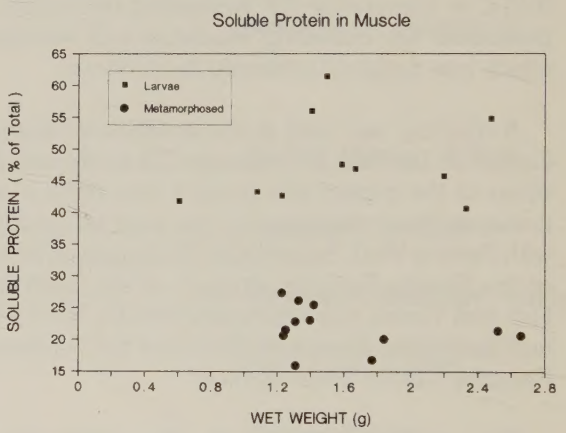



**Figure 1**. Percent of total muscle protein which is soluble before and after metamorphosis of Dover sole larvae.

The change in composition of the muscle proteins is predominantly due to a large increase in the structural proteins of the muscle. Myofibrils, the structural unit of muscles, consist primarily of the proteins actin, myosin, troponin, and tropomyosin. Actin was quantified as a representative structural protein in the muscle. Larval fish muscle showed very low amounts of actin (1.85 $\pm$ 0.56 mg/g muscle) as see in Figure 2. Metamorphosis resulted in a dramatic increase in the actin content of the muscle to 14.22 $\pm$ 3.15 mg actin/g muscle. Thus, actin constitutes 10% of the total muscle protein, a value very similar to that seen in adult white muscle. The increase in actin after metamorphosis represents an 8-fold

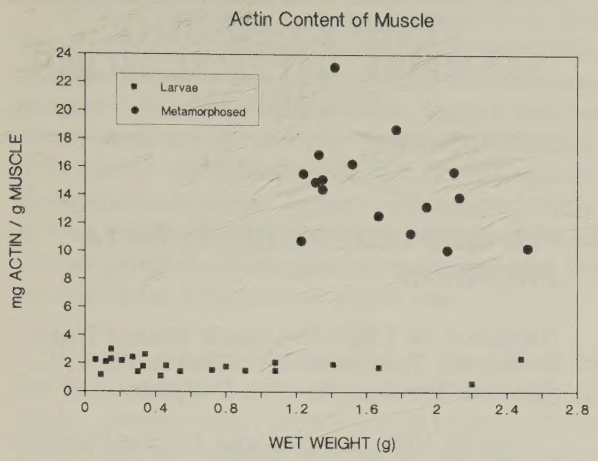



**Figure 2**. Actin content of muscle before and after metamorphosis of Dover sole larvae.

increase, compared to only a 2-fold increase in total muscle protein.

Increased proportions of structural proteins could have profound effects on the swimming ability of Dover sole larvae. Further studies are in progress to determine other changes during metamorphosis and to relate these specific changes in muscle structure to the physiology and ecology of the larval fish. (M. Lowery, FTS 893-7127)

## SURVEY SYSTEMS DEVELOPMENT AND EVALUATION

### Quality-Controlled Deep-Bongo Tow Development

Two of the most important developing resources on the west coast, Dover sole and sablefish, inhabit depths and proximities to the bottom at which they cannot be censused with echo sounders and where trawling and swept-area methods may be too costly or ineffective. Some of the population may be deeper than the commercial fishery trawl can reach. Another, the pelagic egg and larva stages of Dover sole are not confined to the epipelagic layer (0-200 meters) and the egg stages of the sablefish are excluded from the upper 200 meters. For this reason we are developing alternative biomass estimation techniques which use fecundity and egg production rates through the entire water column. A requirement for doing this is a quantitative integrating net towed from the bottom to the surface.

Oceanographers Ron Lynn and Ken Bliss have affixed a surplus Plessy CTD to the towing wire and Biologists Bill Flerx and Ron Dotson have mounted a specially-weighted, 70 cm Bongo net. From trial samples in 1987, we have determined the towing strategy which will give an adequate sample of eggs and which will be representative of the entire water column. In Figure 1, we have illustrated the trajectory of the net (inverted) and the rates of sinking and recovery from tows made in late February off Central California. Ship speed is adjusted to counteract the differences in water motion at depth and at the surface. It appears that we can achieve precision in ascent rate of $\pm$ 5 meters per second at intervals of approximately 5 minutes and that systematic biases in water filtered per unit depth can be minimized. Two advantages of an oblique tow over a vertical tow are that the volume of water filtered can be regulated without changing nets and that the net tow trajectory is isolated from the roll period of the ship. (P. Smith, FTS 893-7169)

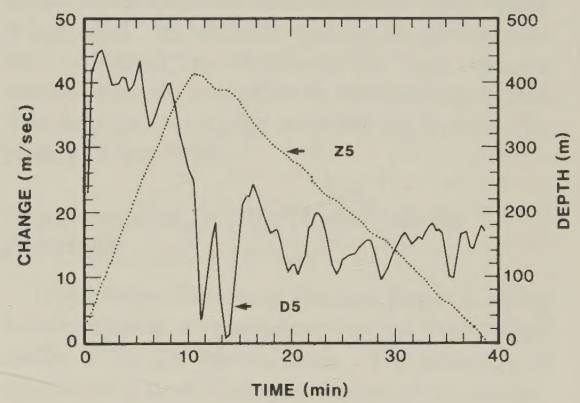



**Figure 1**. Trajectory of the net (inverted) and the rates of sinking and recovery from tows made in late February off central California.

### Bathymetric Data Employed in Development of Random Sampling Patterns for Groundfish Surveys

The Southwest Fisheries Center's groundfish research program has adopted the FAO protocol for demersal fish surveys. This methodology requires stratified random samples. John L. Butler, Fishery Biologist, has completed writing computer programs that randomly choose stations within three depth strata in the survey area off Morro Bay. A large data base of bathymetric observations, consisting of 75 files on 6 tapes, was purchased from the Geophysical Data Center of the National Ocean Survey to assist in

selecting stations and calculating the area of each depth strata. Because of the large size of this data base, nearly 5 million records, it was loaded on the CRAY Super- computer at UCSD for processing. Programmer Karin Forney wrote a program to access the files, select records with valid bottom depths and convert all depth units to meters. With this program, Oceanographer Larry Eber extracted seven subsets of data, representing the survey area, for transmission from the CRAY to his PC-AT microcomputer at La Jolla. These data were converted to fathoms and averaged for areas of one square nautical mile (one minute of latitude) to determine grid point values on a rectangular grid. This grid was contoured and integrated for three depth strata, 30-250, 250-550 and 550-700 fm. Figure 1 shows the selected bottom contours. Trawl stations were randomly chosen within each strata so that fish densities can be extrapolated to populations from the area of each strata.

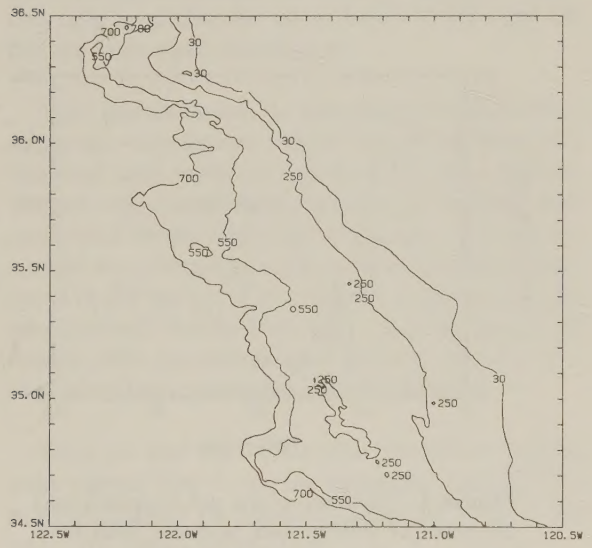



**Figure 1**. Bathymetric data employed in development of bottom sampling.

The software developed for this survey is not tied to fixed contour intervals and can easily be altered for other depth strata. Each station can be evaluated to determine whether bottom trawls are feasible, or not, prior to each survey cruise, rather than on an ad hoc basis. (J. Butler, FTS 893-7149 or L. Eber, FTS 893-7167)

# FISHERY-MARINE MAMMAL INTERACTIONS DIVISION

La Jolla, California

## FISHERY INDEPENDENT DATA PROGRAM

### Analyses of 1986 Research Vessel Data to Detect Trends in Abundance of Eastern Tropical Pacific Dolphins

During 1986 the National Marine Fisheries Service began conducting long-term research vessel surveys to determine whether the abundance of dolphins affected by interactions with the eastern tropical Pacific tuna purse-seine fishery was declining. The monitoring program was initiated in response to the revisions to the Marine Mammal Protection Act made in 1984.

The experimental design of the survey utilizes two research vessels for at least 5 years during which six surveys will be conducted. Each survey year involves 240 sea days. Based on historical information, after the sixth survey an annual decrease of 10% per year would be significantly different from the null hypothesis (i.e., no change in population size from year to year). Given the actual data collected during the 1986 surveys, a slightly larger annual rate of decline is needed to reject the null hypothesis. Specifically, a 10% decline could be detected after 8 surveys or a 15.7% decline after six surveys. The actual number of surveys required to detect an annual decline of 10% is obviously dependent on the entire data set collected over all years.

In the analysis of the 1986 data, density estimates were calculated for two options: using dolphins of all school sizes (referred to as the "all schools" option) and using only schools containing 15 or more animals (referred to as the "large school" option). The large school option was calculated because it is thought that small schools on the ships' tracklines may be more difficult to detect during rough weather and may have been missed at a variable rate depending upon prevailing weather conditions. In addition, population abundance estimates were calculated for several different data stratification schemes: 1) stratifying the estimates by area and pooling areas, and 2) weighting estimates by the area in a particular stratum and pooling estimates over all strata.

Schools detected at great distances from the trackline tend to include a disproportionate number of large schools. This biases school size estimates upward and species proportions toward species which occur in large schools. To minimize this bias, only schools sighted within 3.7 km (2 nm) were included in the analysis. To account for any additional bias within the 3.7 km path, school size and species proportion estimates were weighted by the inverse of the logarithm of school size.

Relative estimates of population abundance of the target species were computed as a function of school density, mean school size of target schools, proportion of dolphin schools which are target schools, proportion of individuals of species i in target schools, and the area inhabited by species i. The variance of population abundance was calculated using a Taylor series approximation.

Estimates of mean school size of all target species varied by strata. Schools in the south stratum were more than twice the size of schools in the middle stratum. The estimates for mean school sizes of target schools in the total area, for pooled data, were 78.6 for all schools and 99.13 for large schools. The estimate of target schools size for large schools was half of previous estimates, which include data from aerial platforms. However, the 1986 estimate is similar to previous estimates collected aboard research ships. The previous estimates from airplanes may have been biased upwards because large schools are more susceptible to detection from aircraft. Because the purpose of this research is to detect trends in relative abundance, this apparent discrepancy with historical data should not be a problem.

The proportion of all identified dolphin schools that included target species ranged from 0.629 in the inshore strata to 0.916 in the middle strata. The proportion of target schools in the total area, for pooled data, was 0.724 (se=0.031) for all schools and 0.853 (se=0.025) for large schools. The proportion of spotted dolphin individuals in all target schools in the four strata ranged from 0.162 to 0.373.

Abundance estimates of some dolphin stocks varied considerably depending on the way data were stratified. For example, estimates of the west central common dolphin stock calculated using pooled and weighted data were 423,400 and 43,300, respectively. These differences occurred because the pooling option used pooled species proportions for the total area and did not account for large differences in species proportion among strata. In general, estimates made with pooled data were thought to be more biased, but also were more precise than estimates made with weighted data. Again, because we are trying to detect trends in relative abundance, it is likely that data that are biased, but precise will be of more use than data that are unbiased, but imprecise. This of course assumes that there are no trends in bias over time.

Population abundance estimates for northern offshore spotted dolphins varied between 913,100 and 1,608,700 animals, depending on the way the data were stratified and what school size option was used. The coefficient of variation varied between 0.19 and 0.25. It is not obvious at this time, what combination of pooling and other options will be used in testing whether a particular stock of dolphins is increasing or not over the next 5 years. Comments from the Service's Survey Design group and other constituents will be considered before a final analysis is accepted. In addition, the results of information collected by observers on tuna vessels should also be available in interpreting trends that may have occurred over the last 5 years. (R. Holt, FTS 893-7098)

**Population of Pacific Harbor Seals Assessed**

Operations Research Analyst Peter Boveng has completed an assessment of the population status of Pacific harbor seals. The assessment utilized data on abundance, collected by personnel from the California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), Washington Department of Wildlife (WDW), Hubbs Sea World Research Institute (HSWRI), Cascadia Research Collective, SWFC and NWAFC. Those data, in the form of counts during peak abundance ashore, were used to produce a minimum population estimate of 35,659 seals on the west coast of the continental United States.

However, at any particular time, the number of seals ashore will underestimate the total population size because some seals remain at sea. Studies of haul-out patterns, using radio telemetry, indicate that the total population size is about 1.4 times the number obtained by counting during peak abundance on shore. Therefore, the total population was estimated to number about 49,900.

Counts of harbor seals in many areas appeared to increase by 10 to 15 percent annually through the 1970s but the extent to which the increase was due to progressively improved census technique is not known. Analysis of population trends in recent years is complicated by the effects of El Niño in 1983 (Figure 1). The time series of counts obtained subsequent to El Niño is too short to reliably estimate recent growth rates.

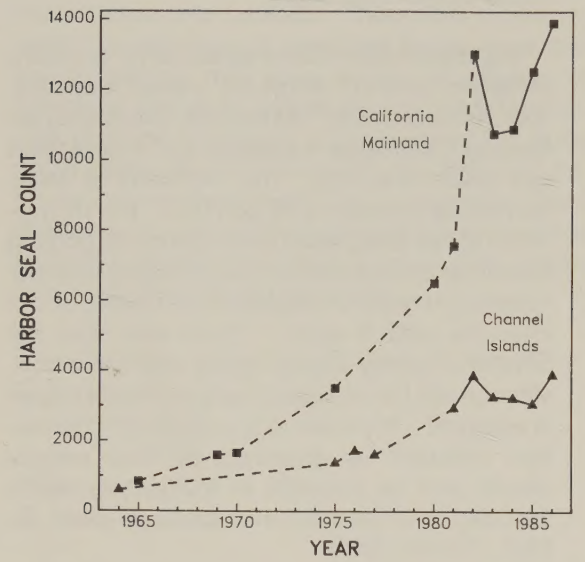



**Figure 1**. Harbor seal counts from mainland California and the Channel Islands. Dashed lines indicate that he counts were obtained by several techniques which may not be comparable. Solid lines connect counts which were collected by consistent technique.

Estimates of the numbers of harbor seals killed incidentally to gill net fisheries were obtained from CDFG, ODFW, and WDW. Those estimates suggest that less than 4 percent of the stocks in Washington and Oregon are taken annually. Incidental mortality in California during the 1985 fishing season was estimated to be 8.4 percent of the stock size. However, considering the uncertainty in abundance and mortality estimates, that value may have been as low as 4.5 percent or as high as 14.4 percent of the stock size.

The available data were insufficient to use techniques such as back-calculation or dynamic response analysis to rigorously determine status relative to the optimum sustainable population (OSP) size (the management goal of the Marine Mammal Protection Act). However, evidence such as the upward curvature in growth curves (e.g., Figure 1) suggests that the population may still be below the lower limit of the range called OSP. (P. Boveng, FTS 893-7173)

## FISHERY DEPENDENT DATA PROGRAM

### Oceanographic Data Analyzed to Assess Effects of Habitat Variability on Distribution and Abundance of Dolphin Stocks in ETP

Basic biological oceanographic data are collected on Monitoring of Porpoise Stocks (MOPS) surveys to assess the effects of habitat variability on the distribution and abundance of dolphin stocks in the eastern tropical Pacific. During the first year's survey, 29 July-6 December 1986 on the *David Starr Jordan* and *McArthur*, Stephen Reilly's staff in the Dolphin Distribution Task measured temperature, salinity, chlorophyll, and nutrients for this purpose.

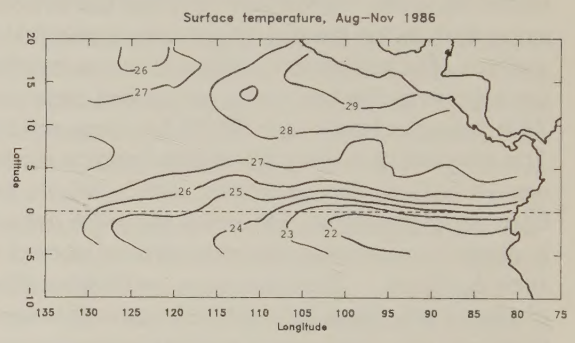



**Figure 1**. Sea surface temperature (°C) from expendable bathythermographs dropped by MOPS ships, other NOAA ships on EPOCS cruises, and ships of opportunity in August-November 1986.

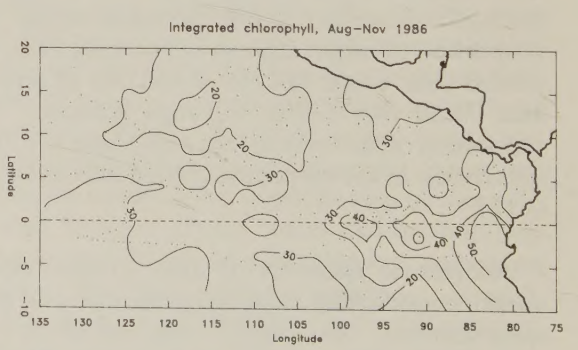



**Figure 2**. Surface chlorophyll (top, mg/lm$^3$) and integrated chlorophyll (bottom, 0-200m, mg/m$^2$), August- November 1986.

Sea surface temperature is mapped in Figure 1 (D. Behringer, NOAA Atlantic Oceanographic and Meteorological Laboratory). The equatorial tongue of cold water is caused by equatorial upwelling and by westward advection of Peru Current water in the South Equatorial Current. This feature is normally well-developed from August to October, during the peak southeast trade winds of southern winter. However, the entire SST field is about 1°C warmer than normal in 1986. The weak 1986-1987 El Niño was just beginning at this time.

Oceanographer Paul Fiedler has mapped surface and integrated chlorophyll in Figure 2. These maps show enhanced production along the equator and in the Costa Rica Dome at 6°N, 85°W. No climatology exists for eastern tropical Pacific chlorophyll, but the 1986 levels and pattern are very similar to EASTROPAC results from August-September 1967. This indicates no effect on primary production at this early stage of El Niño. Meteorological and oceanographic indices of El Niño peaked in summer 1987. The 1987 survey data, now being processed, may therefore yield different results. Analysis of nutrient data will help us interpret these chlorophyll observations and the importance of primary production in the dolphin habitat (P. Fiedler, FTS 893-7016).

## BIOLOGY PROGRAM

### Laboratory Parameters Studied as Indicators of Population Status for Northern Offshore Spotted Dolphins

In conjunction with the 5-year dolphin survey cruises designed to estimate trends in population abundance, the staff of the Biological Assessment Program has been studying a suite of life history parameters as potentially suitable indicators of population status for northern offshore spotted dolphins. These life history parameters may be classified as either age independent or age-dependent. Age-independent parameters include reproductive rates, calving interval, lactation period, sex ratios, proportion of young in the kill, and reproductive seasonality. Age-dependent parameters include age-specific reproductive rates (e.g., pregnancy rates), age at sexual maturation, growth rates, and age at formation of dentinal transition layers.

In past years, estimation of age-independent and age dependent life history parameters have been made combining data from spotted dolphins collected throughout the range of the northern offshore stock. The results from these analyses have not produced trends that could be used to monitor population condition. Due to the extensive area of the spotted dolphins' range, we are now stratifying into smaller, more discrete areas that correlate with the fishing history of the tuna fleet. This new approach may remove potentially confounding factors induced by fishery activities or spotted dolphin movement patterns, thus enabling us to detect trends in life history parameters.

In order to examine the effects of the tuna fishery on dolphin life history parameters, components of time and area must be considered. Distinct geographic areas of the fishery have been identified as high, medium, and low effort by the cumulative number of sets. The geographic area selected for examination of temporal trends in these parameters is that which has been exposed to moderate fishing effort. This region is the far- western part of the fishery, outside the CYRA, to which the fishery expanded in 1968. Fishery and data collection for the area began simultaneously, and this area therefore affords us the best opportunity of detecting temporal trends correlated in with fishing effort. The moderate effort area was also selected because the distance separating this area from that of the major fishing grounds, those inside the CYRA, is relatively large. This distance may be large enough to minimize the effects of migratory movements.

Using teeth collected from northern offshore spotted dolphin in the moderate fishing effort area, the program staff has proposed to investigate specific age-dependent parameters by examining trends in: 1) age at sexual maturation (ASM), 2) transition layer formation, and 3) calcium resorption. The common element linking these proposals is that all have the potential for providing quantitative indices of population condition. Additionally, all require the preparation of a carefully selected sample of teeth from northern offshore spotted dolphins.

Preliminary investigation for each of the proposed projects indicates that detecting trends in ASM may be the most demanding in terms of the number of samples required. Susan Chivers, Fishery Biologist, evaluated the ability to detect a trend in ASM based on available information about the estimation of ASM. A study investigating a variety of techniques to estimate ASM was conducted by Aleta Hohn, Fishery Biologist. This methods study provided information about

the number of teeth required to estimate ASM, estimates of ASM for spotted dolphins, as well as estimates of variance. The procedures for calculating statistically detectable rates of change are described in a recent Ecology [68(5):1364-1372] publication by Dr. Tim Gerrodette, of the Honolulu Laboratory, entitled "A power analysis for detecting trends."

Results of the power analysis were presented by Chivers at a meeting held in late January 1988, at which time the experimental design for execution of the studies was outlined. Significance levels of =0.05 were selected as most appropriate for our study, and then, the selection of an appropriate sample size to balance detecting a biologically realistic trend with a realistic number of tooth preparations was determined. The result of the analysis and general discussion of research proposals, was that 1000 teeth, that is, 50 teeth per year, would provide both a reasonable sample to estimate ASM and an acceptable chance of detecting a significant trend over the 20-year period: 1969-88. A statistically significant trend of 15.6% or greater would be detectable, which is equivalent to a change in ASM of 1.87 years. Utilizing the same sample of teeth, the second research proposal concerning trends in the formation of transition layers will be investigated by Hohn and Priscilla Akin, Fishery Biologist. Evidence for the formation of a transition layer is found in baleen whale ear plugs. Baleen whales exhibit a sharp decrease in the thickness of layers deposited at approximately the age at which sexual maturity is reached. Additionally, a small sample of teeth collected from bottlenose dolphins have been examined by Hohn, and all exhibit a sharp transition layer comparable to that found in the ear plugs. If a transition layer can be identified in spotted dolphins, this study may provide us with a good indicator of fishery effects on the age at attainment of sexual maturity as animals that matured prior to the start of the fishery may be examined.

Al Myrick, Fishery Biologist, proposed the third research topic concerning calcium resorption. Myrick has examined a number of prepared tooth sections for evidence of calcium resorption. Calcium resorption may serve as an indicator of stress induced by fishing operations; increasing stress increases the degree to which calcium is resorbed from the teeth. Myrick is now interested in pursuing his investigation of this trait and quantifying the occurrence of calcium resorption with intensity of fishing pressure.

The projects outlined above, are the first phase of a more comprehensive study to examine trends exhibited by life history parameters. The projected completion date for this phase is June 1989. A more comprehensive assessment of trends will include comparison of high, medium, and low areas of fishing effort. Further research questions will be addressed when we have determined whether there are temporal trends. The results will enable us to better evaluate sample size requirements for comparisons of area. With each phase of the study, we hope to be able to better correlate life history parameters with fishing activity and trends in population abundance. (S. Chivers, FTS 893-7093)

# HONOLULU LABORATORY

Honolulu, Hawaii

## PELAGIC RESOURCES INVESTIGATION

### Sample Size Requirements Determined for Tuna Length-Frequency Sampling

Jerry A. Wetherall, Chief of Pelagic Resources Investigation, and Marian Y. Y. Yong, Mathematician, recently completed a study of sample size requirements for monitoring length composition in tuna purse seine catches. The work, which is to be published in the NOAA Technical Memorandum Series, was motivated by the new tuna access agreement in the South Pacific and by the need to review existing sampling protocols at Pago Pago, American Samoa, where many U.S. tuna seiners off-load their catches.

The sample size question was explored with respect to a specific statistical criterion; namely, the detection of a given difference in the length-frequency distribution between any pair of time-area strata, with specified probabilities for Type I and Type II errors. This criterion is appropriate for sampling objectives in the early stages of the tuna catch monitoring program, when patterns of heterogeneity in size composition and adequacy of time-area stratification schemes should be evaluated.

Sample size requirements were estimated by using Monte Carlo techniques. A set of alternative hypotheses was defined with respect to the length distributions in a typical pair of time- area strata. Length distributions were assumed to be mixtures of Gaussian components with specified means, coefficients of variation, and mixing proportions. Each alternative hypothesis (contrast) was characterized by differences in the underlying distribution parameters. For each pair of hypothetical distributions, a microcomputer algorithm was used to generate random samples of specified size and to compute the two-sample Kolmogorov-Smirnov (K-S) maximum absolute difference statistic. The sampling process was repeated for a large number of replicates, and empirical probability distributions for the K-S statistic were generated for each contrast.

Because the K-S test is conservative when applied to discrete data and is affected by the grouping interval used in compiling length-frequency statistics, preliminary computer simulations were done to estimate the true "size" of the K-S test under typical sampling conditions. Specifically, it was assumed that the hypothetical tuna were measured to the next lowest whole centimeter, as is usually recommended in field manuals, and grouped by 1-cm intervals for the analysis. Under these circumstances, experiments showed that theoretical critical values for the two-sample K-S test, as tabled in standard statistical references, should be multiplied by a factor of 0.93 to provide a test of correct size; i.e., with the desired nominal Type I error probability. As expected,

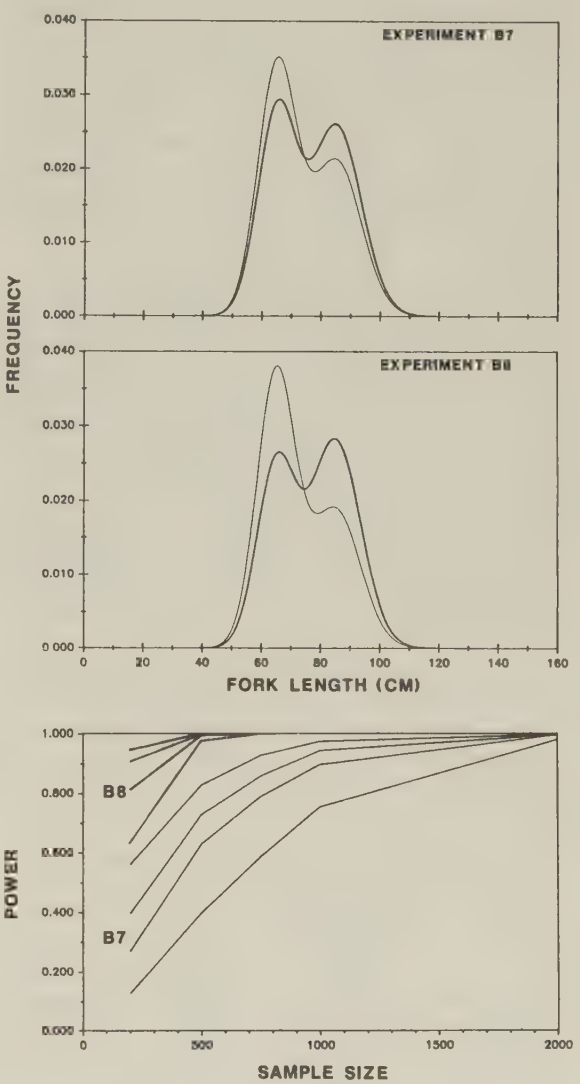



**Figure 1.** Underlying length-frequency distributions for two bimodal contrasts and associated power curves for the Kolmogorovsmirnov two-sample test. In each experiment, power curves are shown for significance levels of 20, 10, 5, and 1% (from top to bottom).

power curves proved to be quite sensitive to this adjustment.

Monte Carlo experiments were then conducted to estimate power curves for the K-S test with respect to 16 contrasts--10 involving bimodal length-frequency distributions and 6 involving unimodal situations. Limited trials were also carried out with some trimodal cases. Figure 1 shows the underlying hypothetical distributions and estimated power curves for two of the bimodal contrasts (Experiments B7 and B8). In Experiment B7, the length distributions in the pair of time-area strata differed only in their mixture.

The Monte Carlo results show that, if the distributions in Experiment B7 hold, about 1,000 fish should be measured in each stratum to provide an 85% chance of rejecting the null hypothesis at the 5% significance level, with the adjusted K-S test. Under the conditions of Experiment B8, only about 300 length measurements in each stratum would be needed to satisfy the same objectives.

As expected, the simulations showed that sample size requirements increase in proportion to the number of components in the length- frequency distributions; i.e., in proportion to the number of ways a pair of distributions may differ. Further, they suggested that present rules for length-frequency sampling (e.g., 500-650 fish per time-area stratum) assure only minimal power with respect to many contrasts likely to be of interest to researchers. Of course, in setting sample size guidelines, the choosing of criteria is a critical step. Unfortunately, it is usually given scant attention. In the absence of a rigorous analysis of sampling objectives for tuna length-frequency sampling, it would be prudent to take larger samples than are now typically recommended, say 1,000 fish per time-area stratum. (J. Wetherall (808) 943-1258)

### Seminars Conducted on Tuna Tracking

Richard Brill conducted two seminars on tuna tracking, February 13-14, at the Tuna Seminar Series, which was sponsored by the Atlantic Offshore Fisherman Association as part of the Atlantic Fisherman Exposition in Newport, Rhode Island. Specifically, his presentations focused on the vertical and horizontal movement patterns of yellowfin tuna, *Thunnus albacares*, and bigeye tuna, *T. obesus*, in relation to fish aggregating devices. These data were gathered as part of a tuna tracking program jointly funded and conducted by the NMFS and the University of Hawaii Sea Grant Program, in association with Dr. Kim Holland of the Hawaii Institute of Marine Biology. Attendance at the seminars was high, about 200 people each day, and would have been twofold had seating not been limited. (R. Brill (808) 943-1266)

## INSULAR RESOURCES INVESTIGATION

### Lobster Stocks Assessed in the Northwestern Hawaiian Islands

The third annual report on the status of the lobster stocks in the Northwestern Hawaiian Islands (NWHI) was recently completed by Task Leader Jeffrey Polovina, Fishery Biologist Robert Moffitt, and Biological Technician Raymond Clarke. Using data from commercial logbooks and research sampling, the report examines the changes in the stocks of slipper lobster, *Scyllarides squammosus*, and spiny lobster, *Panulirus marginatus*, and forecasts the 1988 yield curve.

In 1987, the combined catch rates of the commercial fisheries for slipper and spiny lobsters declined from 1986 levels at all banks (Figure 1), even though effort also declined. This, it is believed, is due to a rapid increase in fishing effort on stocks that previously were lightly ex-

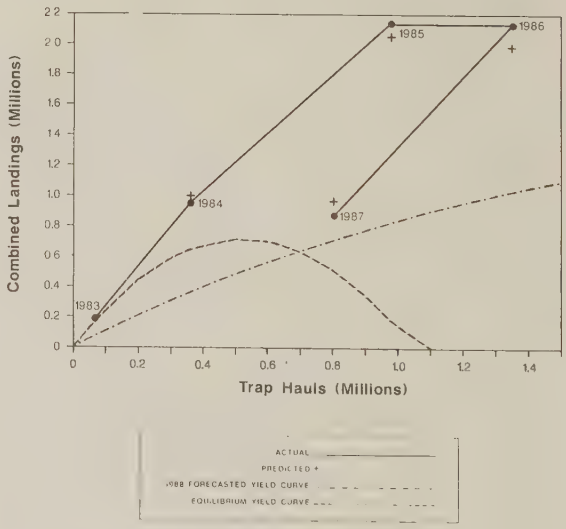



**Figure 1**. Combined landings of spiny and slipper lobsters by trap hauls in the Northwestern Hawaiian Islands in 1983-87, plus the predicted landings, 1988 forecast, and equilibrium yield curve.

ploited and to catch rates not yet in equilibrium. According to the size frequency data, the larger banks (Gardner Pinnacles, Maro Reef, and Necker Island), which have been the best producers for the fishery, still have good recruitment to the fishery, but relatively few sublegal lobsters appear in samples from at least Raita Bank, which has been a sporadic producer. The rates of recruitment to the fishery may vary considerably between banks. Since 1977, when sampling began at Maro Reef and Necker Island, the size at onset of egg production has significantly declined, probably as a population response to the fishing.

The report also introduces a dynamic surplus production model to develop a forecast of the 1988 yield curve. There are four areas (the larger banks and the NWHI) that have been fished for the past 5 years. The parameters of the dynamic model are estimated by fitting the model with a system of four simultaneous equations, one equation for each area, with one common parameter shared by all areas. The model forecasts that if effort in 1988 is unchanged from 1987, the catch will be 84% of the 1987 catch. The model estimates an equilibrium maximum sustainable yield of 716,000 lobsters, with an effort of about 500,000 trap hauls. (J. Polovina (808) 943-1218)

## FISHERY MANAGEMENT RESEARCH PROGRAM

### 1987 Lobster Fishery Statistics Calculated for the NWHI

The lobster fishery in the NWHI ended on a mixed note in 1987, according to Raymond Clarke. Individual vessels did quite well on the average, but the catch for the fishery as a whole was down considerably from 1986. The catch of legal spiny lobsters (394,600 lobsters) and total slipper lobsters (476,600 lobsters) was only 41% of the combined level for 1986. Fishing effort (902,500 trap-nights) also was down (62% of the 1986 effort). Thirty-eight trips were made in 1987 by 11 vessels, compared to 60 trips by 16 vessels in 1986. Much of the change in fishing effort is attributed to the larger vessels returning to the Alaska and Washington fisheries at the end of the record 1986 season. At year's end, eight vessels remained active in the fishery.

Catch-per-unit effort in 1987 for legal spiny lobsters was 0.44 lobster per trap compared to 0.62 in 1986; for slipper lobsters, it was 0.53 in 1987 compared to 0.85 in 1986. There apparently are several reasons for the decline in catch-per-unit effort: fishing down to maximum sustainable yield of slipper lobster stocks, poor weather and operating conditions, and a change in the composition of the fleet.

Prices were very high during most of 1987, but demand "softened" substantially as the year concluded. Spiny lobster tails reportedly were selling at $13.50-14.00 per pound and slipper lobster tails at $11.50-12.50 per pound at year end.

Regulations requiring a minimum tail width size for slipper lobsters and escape gaps (vents) in lobster gear came into effect at the beginning of 1988. (R. Clarke (808) 943-1213)

### Hawaii's Bottom Fish Fishery in 1987 Examined

The 1987 fishing season for bottom fish was similar to that in 1986, according to Biological Technician Kurt Kawamoto. Although analysis of data from the Honolulu Laboratory's market sampling program has not been completed, the preliminary analysis indicates that the number of NWHI bottom fishing trips decreased from 160 in 1986 to 133 in 1987, even though the number of participating vessels rose slightly (from 24 to 28 vessels). At the end of 1987, 8 of the vessels were still active on a full-time basis. The others had either dropped out of the fishery, left Hawaii, or were concentrating on other Hawaii

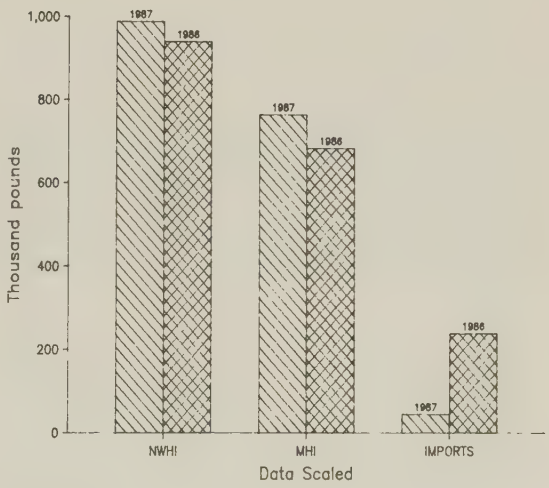
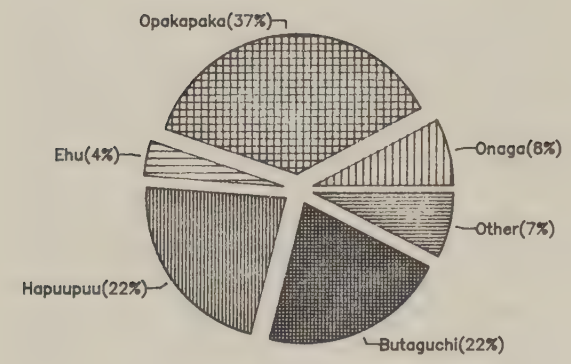
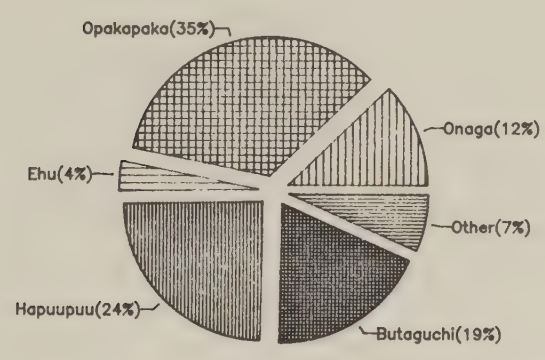



**Figure 1**. Total market landings of bottom fish for the Northwestern Hawaiian Islands (NWHI), main Hawaiian Islands (MHI), and imports for 1987 and 1986.




1987




1986

**Figure 2**. The species composition of bottom fish landings in lthe Northwestern Hawaiian Islands in 1987 (top graph) and 1986 (bottom graph).

fisheries (especially longline tuna). Total market landings, as sampled by the Honolulu Laboratory, for the NWHI, main Hawaiian Islands, and imports are presented in Figure 1. The species composition of NWHI landings is presented in Figure 2. The data are roughly scaled to adjust for total market quantities.

No definite conclusions can be made about the status of the fishery until the data have been analyzed by area fished and adjusted to cover trips not sampled in 1986 or 1987. The 1987 annual report prepared by the Plan Monitoring Team will be completed by mid-1988, with draft reports completed by April 1988. (K. Kawamoto (808) 943-1210)

## Marine Resources Initiative Completed

Recommendations for a scientific research initiative on the marine resources and environment of the main Hawaiian Islands (MHI) were delivered in January to William Paty, Director of the Hawaii Department of Land and Natural Resources, by Richard S. Shomura, Director of the Honolulu Laboratory.

The research recommendations were developed by an ad hoc group of Federal, State of Hawaii, University of Hawaii, and private scientists who met several times in November and December 1987 to plan ways to address the apparent problems facing the MHI's fisheries as well as Hawaii's other marine resources and marine environment. Paty is expected to present the recommendations to the 1988 Hawaii Legislature; the document is also being circulated to researchers of the University of Hawaii Sea Grant Program.

Three broad goals were identified for the research initiative:

(1) to understand the basic biology and productivity of important living marine resources, particularly fishery resources,

(2) to determine the impact of human activity and natural changes on the marine environment and living marine resources, and

(3) to develop management strategies for conserving and enhancing important living marine resources.

Priority objectives were linked together in a logical structure, and eight research "activity fields" were explored as a means for meeting these goals and objectives. The planning process for the research program also was outlined, along with a time frame for the research.

The report is available as Southwest Fisheries Center Administrative Report H-88-2, 22 p. (S. Pooley (808) 943-1216)

## Hawaii's Commercial Fisheries Change with Time

Laboratory Director Richard S. Shomura has completed a report (Southwest Fisheries Center Administrative Report H-87-21) comparing commercial landings of marine fish in Hawaii

during this century. His report begins with the comment, "'Fishing is not what it used to be," a common complaint today of commercial and recreational fishermen all along Hawaii's extensive waterfront.'"

Shomura compares commercial fish landings in 1900, as measured by J. N. Cobb at the time of Hawaii's annexation as a territory to the United States, to those in 1950 and 1953 and in 1985-86. Total landings were highest in 1950 and 1953, but coastal and neritic landings were highest in 1900. Shomura cites five possible reasons why recorded landings have declined: data shortcomings, overfishing, changes in targeted species, environmental impacts on fishery resources, and pollution impacts. He concludes that sound management decisions can be made only with a thorough understanding of the resources and environment. (R. Shomura (808) 943-1221)

### Western Pacific Position on Fishery Management Issues Examined

The CFR 603 regulations on scientific input to the Fishery Management Plans (FMP's) were examined in a February meeting in Seattle by representatives of the Scientific and Statistical Committees of the North Pacific, Pacific, and Western Pacific Regional Fishery Management Councils. According to Sam Pooley, Industry Economist with the Honolulu Laboratory, discussions centered on proposals from NMFS to mandate a threshold of fishery biomass in FMP's.

Richard Schaefer, head of the NMFS Office of Conservation and Management, stressed Dr. William Evans' commitment to developing a threshold standard to prevent overfishing. Representatives from the North Pacific and Pacific Management Councils agreed with this concept but had technical reservations about its specification. Representatives from the Western Pacific Regional Fishery Management Council (Council) concluded that a mandated, numerical threshold was not useful and might be counterproductive. Despite the differences over the threshold and its application, the meeting appeared to be productive. Schaefer asked for detailed written comments from the Scientific and Statistical Committees in preparation for a revision of the draft guidelines, which he suggested would be ready this summer. The Council reaffirmed its position on the proposed regulations at its March meeting. (S. Pooley (808) 943-1216)

## WPACFIN PROGRAM

### Data Processing System Upgraded for American Samoa

A data processing system for the American Samoa Department of Marine and Wildlife Resources (DMWR) recently was redesigned by David Hamm, the Western Pacific Fishery Information Network (WPACFIN) Program Manager; Michael Quach, Computer Programmer; and Fini Aitaoto, DMWR Data Base Manager. The new processing system was developed because of major changes in fishery data collection by DMWR. The DMWR formerly interviewed only commercial fishermen to collect data on catch, effort, and species composition of the offshore fisheries but, in October 1986, began interviewing the recreational fishermen as well. The new processing system uses these data on the commercial and recreational fisheries to estimate the total commercial catch and value by species. The most immediate use of the processing system is for producing American Samoa's chapter in Fishery Statistics of the Western Pacific, which is due out in April.

Hamm also traveled to Guam and Saipan to work with their fisheries staffs. Several data processing problems were solved in Guam, and hard-wired communication links were established between Apple and IBM computers to facilitate additional analysis of existing data. In Saipan, Hamm implemented a data expansion system for the offshore creel surveys and trained staff in its use. (D. Hamm (808) 943-1214)

### Meeting Focuses on Next Generation WPACFIN

The ninth meeting of the WPACFIN Fisheries Data Coordinating Committee was held at the Honolulu Laboratory on 23 February 1988. Representatives of all seven member agencies were present, as were visitors from three other agencies. The major topics of discussion were "next generation WPACFIN," funding alternatives, and commitments for the future. Designing and implementing the next generation of processing systems entail standardizing hardware and software on the MS/DOS environment while increasing power, flexibility, and user friendliness. Fisheries offices in American Samoa, the Commonwealth of the Northern Marianas, Guam, and Hawaii will strive to become self-sufficient in all areas of data and

fisheries management--from data collection through analysis and interpretation. The WPACFIN will continue to provide technical support and guidance to the agencies, thereby continuing the cooperative effort to improve fisheries management in the western Pacific. (D. Hamm (808) 943-1214)

# PACIFIC FISHERIES ENVIRONMENTAL GROUP

Monterey, California

## PHYSICAL OCEANOGRAPHY

### Surface Marine Observation Data Set Acquired From National Climatic Data Center

The Pacific Fisheries Environmental Group (PFEG) has recently purchased a series of magnetic tapes of surface marine weather observations along the North Pacific Eastern Boundary Region from the National Data Climatic Center (NCDC). PFEG maintains a nearly complete global tape library of surface marine weather observations for the period 1854-1979 (Figure 1). Recent acquisition of surface marine observation data covering the period January 1, 1980 to December 31, 1986 began during the summer of 1987. The update covers sections of the North Pacific along the North American continental margins. Additional data have been purchased during February 1988 to include the entire eastern boundary region of the North Pacific (Figure 2).

Dave Cole, Jerry Norton, and Dave Husby (all of PFEG) have been using the measured ship winds from these NCDC files to compare with derived winds computed from surface pressure fields of the U.S. Navy's Fleet Numerical Center (FNOC), in Monterey, CA. Preliminary results were presented by Dave Cole at the American Geophysical Union (AGU) Annual Fall Meeting in San Francisco (December 1987).

Calculated (FNOC) and measured (NCDC) monthly mean wind values were compared for a 17 year period from January 1, 1970 to December 31, 1986. Wind speed and direction were resolved into north and east components at four selected locations corresponding to Bakun's existing upwelling index sites (21°N- 107°W, 24°N-113°W, 36°N-122°W, 48°N-125°W). Measured wind components were averaged for a 9x9 degree box surrounding each site to ensure adequate data coverage. The calculated wind values were interpolated to a 3x3 degree grid from the pressure fields.

Preliminary results indicate that the calculation of surface winds from geostrophic winds derived from the FNOC surface pressure field

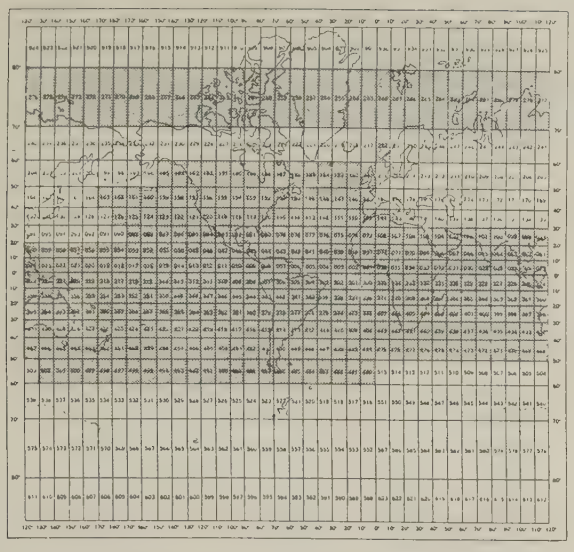


**Figure 1**. Data coverage (shaded) of surface marine observations for the period, 1854-1979.

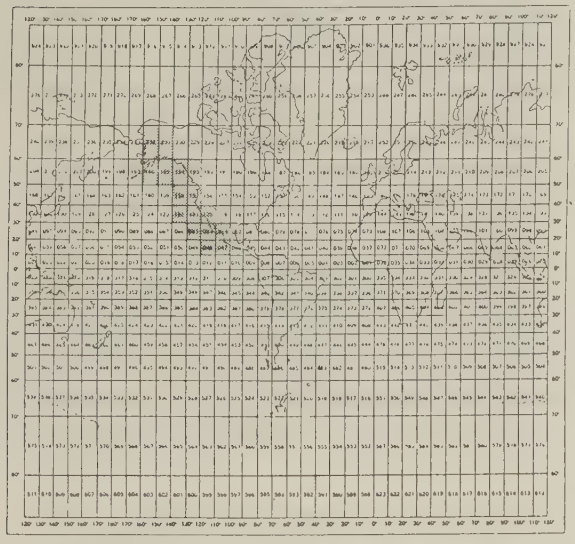


**Figure 2**. Data coverage (shaded) of surface marine observations for the period, 1980-1986.

may need modification to correctly model the observed winds archived in the NCDC historical ship observation files. Better correlation between the observed and the calculated winds exists in the middle and higher latitudes, and an apparent shift in regime became evident after 1976 (especially in the calculated wind series). Further study to verify these preliminary results is planned, with incorporation of the newly acquired data in a more comprehensive study of the region. The historical NCDC series has been used in prior studies by PFEG personnel (wind stress, wind stress curl, etc.). Acquisition of the new data set provides groundwork for similar studies in the future. (D. Cole (408) 646-3311)

# PELAGIC FISHERY RESOURCES DIVISION

La Jolla, California

## MULTISPECIES DATA COLLECTION AND EVALUATION PROGRAM

### 1987 Seychelles Purse Seine Fishery Data Added to Base

Al Coan, Leader of the Multispecies Data Collection and Evaluation Program, has added the fourth quarter data for the 1987 Seychelles purse seine fishery to the SWFC data base. Participation in the fishery during the fourth quarter was 42 vessels. The data represents approximately 73% of the logbooks. Overall catch rates for yellowfin and skipjack tunas was 18 mt/day fishing (15 mt/day fishing in 1986). Overall catches of yellowfin and skipjack tunas are expected to reach 160,000 mt when all the logbooks are received. Skipjack tuna continues to be the dominant species in the catch at 62%. Monthly trends in catches of yellowfin and skipjack in 1987 remain similar to those in 1986, except for catches in April, June and July (Figure 1). (A. Coan, FTS 893-7079)

### Collection of U.S. Purse Seine Data Under the South Pacific Regional Tuna Treaty Planned

A South Pacific Tuna agreement that allows licensing of U.S. tuna purse seiners to fish in the 200-mile zones of some South Pacific Island states is expected to be ratified soon by the U.S. Congress. In anticipation of this ratification, the Southwest Fisheries Center developed plans to implement provisions in the agreement with respect to port sampling of catches made by licensed purse seiners. Recognizing the need to coordinate activities in the plan with the NMFS Southwest Region (SWR) as well as with the Forum Fisheries Agency (FFA), the agency designated by the South Pacific Island governments to handle administration of the agreement, the SWFC planned an information exchange meeting with all parties.

This meeting was held on January 6, 1988 at the SWFC in La Jolla. Attending that meeting were representatives of the SWR, FFA, SWC and South Pacific Commission (SPC). Geographical

sampling strata and procedures for taking length and species composition samples of catches from the licensed purse seiners were agreed to pending review by the South Pacific Island governments. The geographical strata are based on data from the U.S. fleet fishing in the treaty area (Figure 2). The sampling procedures are based on methods developed by the SWC and international tuna organizations. The parties also agreed that NMFS will conduct the port sampling in 1988 and exchange information with the FFA. Sampling procedures will be reviewed by all parties at the end of the 1988 fishing season.

The meeting and agreement on the sampling plan for the 1988 season fulfills an obligation to the South Pacific Island states that was made by U.S. negotiators of the South Pacific Tuna agreement. It also allows NMFS to proceed with collection of fisheries data from the licensed vessels, with confidence that the procedures will meet the needs of the South Pacific Islanders as well as requirements for assessing the condition of the exploited stocks. (A. Coan, FTS 893-7079)

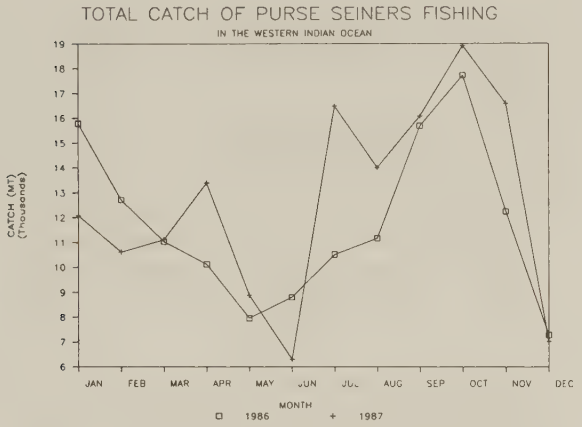



**Figure 1**. Seasonal distribution of catch in the purse seine tuna fishery of the western Indian Ocean.

## STOCK ASSESSMENT AND FISHERY IMPACT ANALYSIS PROGRAM

### Cooperative Swordfish Projects planned

SWFC scientists Norm Bartoo, Al Coan, Dave Holts and Gary Sakagawa met with California Fish and Game (CF&G) biologists in Long Beach this month to plan cooperative swordfish research projects. During the summer and fall of 1988, SWFC and CF&G biologists will conduct sonic tracking experiments using swordfish. These experiments will follow the format and complement similar experiments done during the past 2 years with striped marlin. The tracking will be done in the Los Angeles Bight or site of the commercial swordfish fishery. The experiments will be conducted from a CF&G research vessel working with a commercial swordfish vessel.

Also planned for the spring and summer of 1988 is an extensive data analysis of swordfish catch and effort data. Data from the U.S. fishery will be combined with foreign fishery data to evaluate the condition of the swordfish stock in the Pacific Ocean. (N. Bartoo, FTS 893-7073)

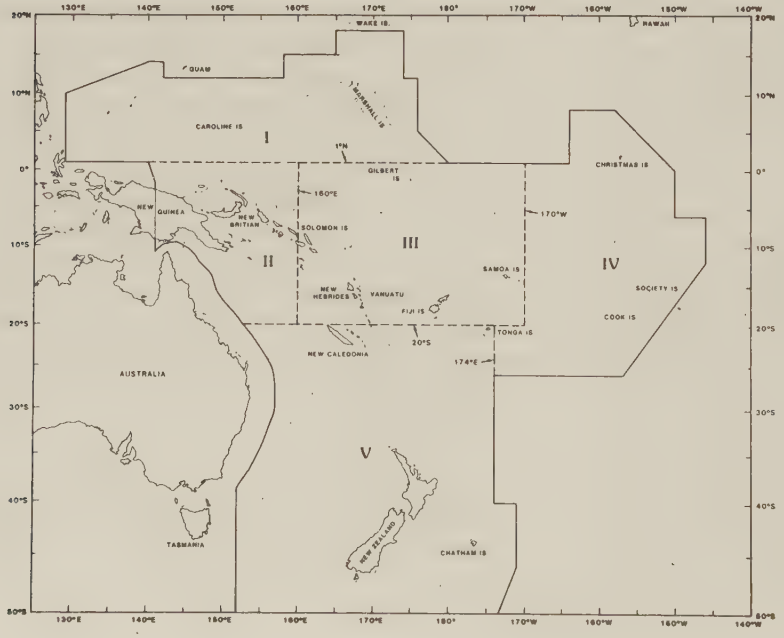



**Figure 2.** Sampling strata (I-V) used to sample landings for size and species composition from U.S. purse seiners licensed to fish in the South Pacific. The strata represents historical data where uniform sizes of yellowfin tuna were caught.

# TIBURON LABORATORY

Tiburon, California

## GROUNDFISH ANALYSIS INVESTIGATION

### Effects of Aging Errors on the Reliability of Sablefish Assessment Data Demonstrated

Substantial effort has been directed toward acquiring sablefish *(Anoplopoma fimbria)* catch-at-age data that can be used to assess stock status. Estimates of sablefish age composition must be interpreted cautiously, however, because sablefish otoliths are difficult to read and agreement among readers is low. Fishery Biologist Joseph Hightower has now obtained preliminary estimates of the reliability of the age data. None of the fish were of known age but some inferences were possible because otoliths from about 3,000 fish from 1986 and 1987 port samples were read independently by two readers.

Between-reader variability was estimated from 1986 age data (ages determined by the Age Reading Unit at the Northwest and Alaska Fisheries Center (NWAFC)). The age assigned by the first reader was used as the reference age. The standard deviation for each reference age was obtained from the ages assigned by the second reader. A nonlinear model was fitted to estimates for both sexes combined (Figure 1).

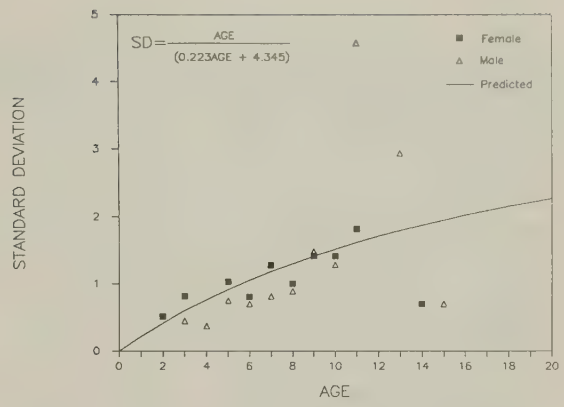



Figure 1. Predicted standard deviation (SD) as a function of age. For each age asssigned by the primary age reader, the observed SD was based on the ages independently assigned to those fish by a second reader.

Errors of this magnitude have a substantial effect on observed age composition when year-class strength is variable. The true age distribution for sablefish was not known, so the effect of aging errors was demonstrated by using a Monte Carlo technique to apply sablefish aging errors to catch-at-age estimates for Pacific halibut *(Hippoglossus stenolepis)*, widow rockfish *(Sebastes entomelas)*, and Pacific whiting *(Merluccius productus)*. These species are thought to be less difficult to age than sablefish. Aging errors had little impact on the simulated age distribution for Pacific halibut, apparently because year-class strength was relatively constant (Figure 2). The simulated age distributions

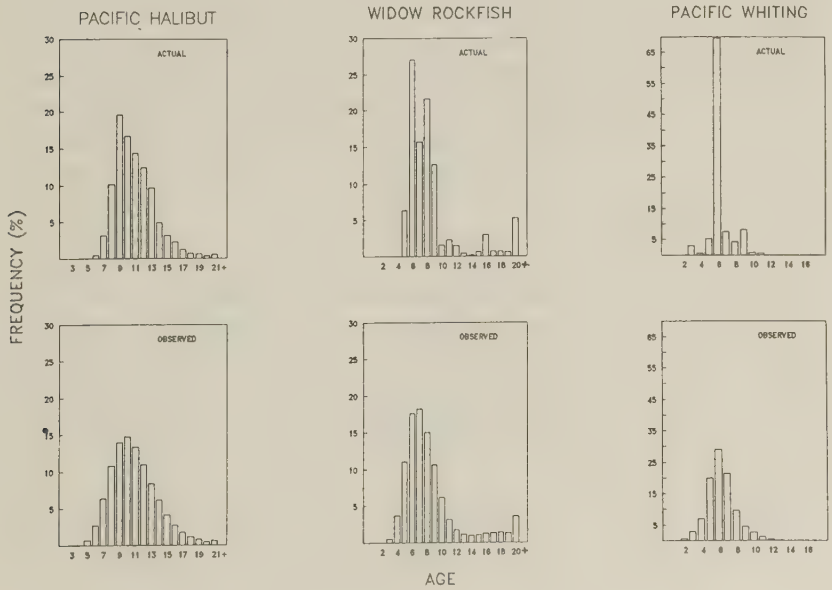



Figure 2. Age distributions from 1986 catch-at-age estimates (actual) and mean observed distributions from simulated samples when errors in aging were applied. Aging errors were of the same magnitude as observed for sablefish.

for widow rockfish and Pacific whiting were substantially altered by aging errors. The apparent differences among adjacent year classes were considerably reduced by aging errors.

Variability among readers also was assessed using 1987 age data provided by Biological Technicians Anne McBride, Don Pearson, Carol Reilly, and David Woodbury of the Tiburon Laboratory. Overall age distributions for the four readers were similar; however, agreement for individual fish was low. For fish landed during the first quarter of 1987, agreement ranged from about 70% at age 2 to around 30% for fish ages 5+ (Table 1). This level of agreement among readers is similar to that observed for readers at NWAFC who have aged sablefish. To improve the reliability of sablefish age data, plans are to conduct collaborative work with other laboratories and to apply image analysis techniques. (J. Hightower, FTS 556-0565)

**Table 1.** Percent agreement between two readers for sablefish ages 1-15. The sample size for each age is n.

| Sex | Reader 1 age | Exact agreement | Within 1 year | n |
|---|---|---|---|---|
| F | 1 | 0 | 100 | 1 |
| | 2 | 65 | 97 | 37 |
| | 3 | 42 | 91 | 43 |
| | 4 | 33 | 78 | 40 |
| | 5 | 39 | 69 | 26 |
| | 6 | 26 | 81 | 27 |
| | 7 | 25 | 40 | 20 |
| | 8 | 30 | 35 | 20 |
| | 9 | 44 | 67 | 9 |
| | 10 | 25 | 44 | 16 |
| | 11 | 22 | 44 | 9 |
| | 12 | 50 | 70 | 10 |
| | 13 | 30 | 40 | 10 |
| | 14 | 25 | 62 | 8 |
| | 15 | 14 | 14 | 7 |
| M | 1 | 0 | 100 | 3 |
| | 2 | 72 | 90 | 39 |
| | 3 | 41 | 82 | 39 |
| | 4 | 32 | 91 | 22 |
| | 5 | 32 | 74 | 19 |
| | 6 | 19 | 38 | 16 |
| | 7 | 33 | 67 | 9 |
| | 8 | 29 | 29 | 7 |
| | 9 | 8 | 33 | 12 |
| | 10 | 36 | 54 | 11 |
| | 11 | 0 | 38 | 8 |
| | 12 | 14 | 29 | 7 |
| | 13 | 9 | 36 | 11 |
| | 14 | 0 | 67 | 3 |
| | 15 | 0 | 17 | 6 |

## GROUNDFISH COMMUNITIES INVESTIGATION

### Northern California Investigation Expanded With Site on Sonoma Coast

The staff of the Groundfish Communities Investigation has expanded its studies off northern California by establishing a site on the Sonoma coast. Investigation staff, led by Fishery Biologist Ted Hobson, have studied the effects of environmental change on fish communities off northern California since 1976, but virtually all of the work has been off the Mendocino Coast (lat. 39°13'N, long. 123°14'W). Since 1983, much of the effort has involved the success of recruitment in the three rockfish species that, as first-year juveniles, are most numerous in northern California nearshore habitats--*Sebastes mystinus*, *S. flavidus*, and *S. melanops*. Underwater counts, most by Fishery Biologists Dan Howard and Tony Chess, have shown substantial temporal and spatial variation in the juveniles of all three species (e.g., see Bimonthly Report, November-December 1987.

The spatial variations are evident when juveniles off Mendocino are compared with their counterparts off the Sonoma coast, about 80 km to the south, beyond Point Arena. The Sonoma juveniles, for example, have been significantly larger this past year (based on samples taken days apart during August ($n = 28$, $t = 4.14$, $P < 0.001$) and January ($n = 31$, $t = 7.04$, $P < 0.001$). It may be that the differences between juveniles from Mendocino and Sonoma reflect differing oceanographic conditions in their respective regions. This possibility gains strength from differences between conditions observed off Mendocino by the Groundfish Communities Investigation, and those reported off Sonoma by the recent multi-agency CODE (Coastal Ocean Dynamics Experiment) studies. On the other hand, the comparisons are weakened by the fact that the assessments of juveniles off Sonoma have been limited and irregular. To add substance and regularity to these assessments and thus establish a sounder basis for the comparison, a permanent study site, with recording thermographs, was established off Sonoma (lat. 38°13'N, long. 124°36'W) during January 1988. (E. Hobson, FTS 556-0565)

# INFORMATION TECHNOLOGY SERVICES

### Installation Commences for Local Area Network at La Jolla

A Molecular 32X multi-user microcomputer now supports much of the word processing activity conducted at the La Jolla Laboratory including the exchange of miscellaneous files and word processing documents among Center staff. The 32X also runs the Center's administrative systems, including the Financial Reporting System (FRS), and provides a modem pool for telecommunications with remote systems and unattended file transfers for remote users.

The installation of a 3COM Local Area Network (LAN) at La Jolla is now underway. The LAN is intended to eventually replace and improve services now available on the 32X. It is planned that the two systems will be run in parallel until the 32X becomes entirely redundant.

The 3COM LAN offers more efficient word-processing (i.e. MS-DOS based WordPerfect 4.2 and Wordstar 4.0) and extended communications services. New services such as electronic mail and internetwork routing are included in the 3COM package. Since the NMFS Headquarters Office in Washington also runs a 3COM LAN, file exchanges and electronic mail between Headquarters and the La Jolla Laboratory can be made much easier by the internetworking of the two LAN's at some point in the future.

The installation of the 3COM LAN at La Jolla has begun with the removal of certain terminals now connected to the Molecular 32X Microcomputer. These terminals have been replaced with Amdek System/286 personal computers which have been temporarily attached to the 32X via terminal emulation software running over existing RS-232 type connections.

The SWFC has a contract with PACTEL Info-Systems for the installation of the 3COM ethernet LAN. This installation will include the initial setup and testing of all server hardware and software as well as the laying of seven segments of thin coaxial cabling and the connection of workstations and peripheral devices. Installation is scheduled to take place on or about May 1, 1988.

In the meantime, the replacement of terminals with PC workstations will enable initial users of the network to become accustomed to differences in the layout of the PC keyboard. Introductory instruction in MS-DOS microcomputer usage and word- processing in the DOS environment will be provided by ITS staff.

Initially, the LAN will be configured to support eight users, representing each of the Divisions and organizational elements. Three of the available seven cable segments will be used. This configuration will focus on providing word-processing services including electronic mail and file exchanges. The initial scope and size of the LAN has been limited in order to take advantage of the opportunity to develop effective usage patterns in a prototype setting. When the prototype phase is complete, additional users can be added to the network and the conversion of the Center's Administrative systems can begin. (F. Ralston, FTS 893-7062)

# STATUS OF PUBLICATIONS

## SWFC SCIENTISTS GARNER ADDITIONAL PUBLICATION HONORS

As noted in the November-December, 1987 Bi-Monthly Report of Activities for the Southwest Fisheries Center, top award for NMFS Outstanding Publications Awards for Fishery Bulletin was made to Gail Theilacker of the La Jolla Laboratory for her 1986 publication, "Starvation-induced mortality of young sea-caught jack mackerel, *Trachurus symmetricus*, determined with histological and morphological methods." Susumu Kato of the Tiburon Laboratory won the award for best publication in Marine Fisheries Review for his 1986 paper (co-authored with Stephen C. Schroeter), "Biology of the red sea urchin, *Strongylocentrotus franciscanus*, and its fishery in California."

In addition, a number of papers by members of the Southwest Fisheries Center staff were singled out by the Outstanding Publication Awards Committee of the Publication Advisory Committee for Honorable Mention Recognition for the year 1986. At the La Jolla Laboratory Albert Myrick, Aleta Hohn, Jay Barlow and Priscilla Sloan were recognized for their paper, "Reproductive biology of female spotted dolphins, *Stenella attenuata*, from the eastern tropical Pacific," published in the Fishery Bulletin.

Also at the La Jolla Laboratory Stephen Reilly and Jay Barlow garnered the Committee's Honorable Mention Recognition for their paper in a 1986 issue of the Fishery Bulletin, "Rates of increase in dolphin population size."

At the Pacific Fisheries Environmental Group, Honorable Mention Recognition went to Richard Parrish, Donna Mallicoate and Richard Klingbeil (the latter of the California Department of Fish and Game) for their paper in the 1986 Fishery Bulletin, "Age dependent fecundity, number of spawnings per year, sex ratio, and maturation stages in northern anchovy, *Engraulis mordax*."

At the Honolulu Laboratory, Honorable Mention Recognition went to David Somerton and his co-author Robert Otto, for their paper in the 1986 Fishery Bulletin, "Distributon and reproductive biology of the Golden King Crab *Lithodes aequispina* in the Eastern Bering Sea". Also receiving Honorable Mention Recognition for their paper in the 1986 Fishery Bulletin, titled "An approach to yield assessment for unexploited resources with application to the deep slope fishes of the Marianas," were Stephen Ralston and Jeffrey Polovina.

Receiving the Committee's Honorable Mention Recognition for their paper appearing in a 1985 issue of the Marine Fisheries Review titled, "Fisheries resource assessment of the Mariana Archipelago, 1982-1985," were: Jeffrey Polovina, Robert Moffitt, Stephen Ralston, Paul Shiota and Happy Williams.

Reginald Gooding, Fishery Biologist, who retired in February 1987 after 32 years on the staff of the Honolulu Laboratory, received the Committee's Honorable Mention Recognition for his paper appearing in a 1985 issue of the Marine Fisheries Review titled, "Predation on released spiny lobster, *Panulirus marginatus*", during tests in the Northern Hawaiian Islands."

As the Publications Advisory Committee noted, "Only those papers constituting an outstanding original scientific work contributing to the NMFS mission were considered." All of the papers listed above the Committee wrote in their letter of notification, "certainly met this requirement."

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**Published**

*Boehlert, G. W. and A. Genin.* 1987. A review of the effects of seamounts on biological processes. In Keating, B. H., P. Fryer, R. Batiza, and G. W. Boehlert (eds.), Seamounts, islands, and atolls, p. 319-334. Geophys. Monogr. 43 (Am. Geophys. Union)

Seamounts interacting with oceanic currents create flow complexities which depend upon current speed, stratification, latitude, and seamount morphology. Seamount effects, which include internal wave generation, eddy formation, local upwelling, and closed circulation patterns called Taylor columns, have important effects upon pelagic and benthic ecosystems over seamounts. The biological effects of these current-topography interactions are poorly understood. Flow acceleration on upper flanks of seamounts may lead to low sedimentation but areas of high standing stocks of benthic fauna, particularly filter feeders. Other effects extend into the water column; nutrient enrichment and enhanced primary

productivity occur over some seamounts. Longer observational periods will be necessary to understand the time-varying nature of such enhanced productivity and the extent to which it remains at the seamount or is advected away. At higher trophic levels, unusual patterns of distribution and abundance occur at some seamounts. Maintenance of high standing stocks of seamount-associated micronekton and demersal fishes suggests that seamounts are locations for high rates of energy transfer. The energy driving this biological productivity may either be generated from in situ processes or be advected from elsewhere and concentrated at the seamount; interdisciplinary studies will be necessary to better understand these ecosystems.

*Hobson, Edmund S. and James R. Chess.* 1986. Diel movements of resident and transient zooplankters above lagoon reefs at Enewetak Atoll, Marshall Islands. Pac. Sci. 40:7-26.

This report identifies adaptive significance in diel patterns of occurrence among zooplankters in shallow water. Of those above the lagoon shelf at dome time during the diel cycle, the vast majority of those larger than 1.5 mm are there only at night. Many are residents that by day shelter on or near shelf substrata, or in swarms close to these substrata, whereas many others are transients from deeper regions of the lagoon, or from the open sea outside the atoll. The residents include various polychaetes, cypriidinacean ostracods, mysids, tanaids, isopods, amphipods and carideans. The transients are mostly holoplankters that include halocyprid ostracods, calanoid copepods, euphausiids, and chaetognaths. Both residents and transients are above the shelf at night following diel vertical migrations, but while the residents are in this habitat with purpose, the transients are here by chance. The residents are adapted to stay within reach of their diurnal habitats while in the nocturnal water column, often by avoiding currents, and so are readily able to return to those habitats at dawn. The open-water transients, however, lack such adaptations, and as a result many are stranded in the shallows above the shelf at dawn, unable to return to their daytime habitats, and probably vulnerable to planktivorous fishes.

*Husby, David M. and Robin D. Muench.* 1988. Hydrographic observations in the northwestern Weddell Sea Marginal Ice Zone during March 1986. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-102, 9 p.

*Keating, B. H., P. Fryer, R. Batiza, and G. W. Boehlert* (eds.). 1987. Seamounts, islands, and atolls. Geophys. Monogr. 43 (Am. Geophys. Union), 405 p.

*Reddy, Michelle L. and Carrie A. Griffith.* 1988. Hawaiian monk seal population monitoring, pup captive maintenance program, and incidental observations of the green turtle at Kure Atoll, 1985. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-101, 36 p.

Data on the monk seal, *Monachus schauinslandi*, were collected at Kure Atoll from 30 January to 23 October 1985. All pups were double-flipper tagged after weaning; the weaned females were maintained in an ocean-beach enclosure until mid-September. The mean count from atoll-wide censuses of monk seals was 24.5, excluding pups of the year, and two tagged turtles, *Chelonia mydas*, were resighted during the 1985 field season. Pelage bleaching aided in the identification of seals from which a minimum population estimate of 68 seals was derived: 55% adults and 45% nonadults. Of the adult population, 40% were males and 15% females, a 2.6:1 ratio. Five pups, two males and three females, were born from early February to mid-July. All were born at the southwest side of Green Island and survived to the end of the field season. Two deaths and eight injuries were observed. The injuries usually involved the cookiecutter shark, *Isistius brasiliensis*. Three incidents of entanglement were observed. Two were of seal pups, one male and one female, entangled in fishing line, and the third was a turtle entangled in trawl net. From 12 June to 22 October, 771 samples of fishing debris that could pose a threat of entanglement to wildlife were collected.

*Shomura, R. S.* 1987. Tuna tagging in the Philippines, Thailand, and Malaysian waters. In Report of the Second Meeting of the Tuna Research Groups in the Southeast Asian Region, Manila, Philippines, August 25-28, 1987, p. 63-74. Indo-Pacific Tuna Development and Management Programme, IPTP/87/GEN/12.

*Smith, Susan E. and Peter B. Adams.* 1988. Daytime surface swarms of *Thysanoessa spinifera* (Euphausiacea) in the Gulf of the Farallones, California. Bull. Mar. Sci. 42:76-84.

Daytime surface swarms of the euphausiid *Thysanoessa spinifera* were observed and sampled in Spring 1985 in the Gulf of the Farallones off San Francisco, California. Samples were dipnetted at the surface from nine discrete swarm patches; and depth-stratified plankton tows were made before, during, and after swarm activity. Analysis of sex and maturity stage of surface patch samples showed that 94 of all euphausiids were in breeding condition. Sex ratios differed significantly in six of the nine patches, with males dominating four and females dominating two patches. This sexual segregation is thought to be related to differences in size between sexually mature males and females. Biological and oceanographic observations at the swarm site,

and examinations of food baskets of swarm individuals, gave little indication that the animals were passively transported to the surface, or that they were there to feed or avoid predators. *T. spinifera* eggs and Stage I nauplii were numerous in plankton collections taken the night following, and day after surface swarming was observed. It is concluded that swarming in this species is related to reproduction. Its adaptive value in regard to different breeding-related activities is still unclear, but probably involves a combination of factors that relate to the timing of sexual maturation, egg release, and larval dispersal in the changeable upwelling environment off central California.

## Approved by Center Director

*Bakun, Andrew.* The ocean and the variability of fish stocks. For publication in book, L'Homme et les Ecosystems Halieutiques et Aquacoles Marins.

*Boehlert, G. W.* Recruitment of pelagic armorhead, *Pseudopentaceros wheeleri*, to isolated seamounts in the central North Pacific. Symposium on Marine Fish Recruitment. Annual meeting, May 6-7, 1988, California State University, Northridge.

*Cole, David A. and Douglas R. McLain.* Interannual variability of temperature in the upper layer of the North Pacific eastern boundary region, 1971-1987. For consideration for publication in Calif. Coop. Oceanic Fish. Invest. Rep.

*Hohn, Aleta A., Michael D. Scott, Randall S. Wells, Jay C. Sweeney, and A. Blair Irvine.* Growth layers in teeth from known-age, free-ranging bottlenose dolphins. For consideration for publication in Marine Mammal Science.

*Leong, Roderick J. H.* Sperm concentrations and egg fertilization rates during spawning of captive anchovy, *Engraulis mordax*. For consideration for publication in Fishery Bulletin, U.S.

*MacCall, Alec D. and Michael H. Prager.* Historical changes in abundance of six fish species off southern California, based on CalCOFI egg and larval samples. For consideration for publication in Calif. Coop. Oceanic Fish. Invest. Rep.

*Polovina, Jeffrey J.* Should anyone build reefs? For consideration for publication in the Bulletin of Marine Science.

*Seki, Michael P. and Craig S. Harrison.* The feeding ecology of two subtropical seabird species at French Frigate Shoals. For consideration for publication in the Bulletin of Marine Science.

*Shomura, Richard S.* Migration patterns of tuna in the Pacific. Proceedings, Pacific Basin Management of the 200-Nautical Mile Exclusive Economic Zone Conference.

*Watson, Cheryl, Robert E. Bourke, and Richard W. Brill.* A comprehensive theory on the biology of burnt tuna. For consideration for publication in Fishery Bulletin, U.S.

## Administrative Reports

*Boveng, Peter.* 1988. Status of the northern elephant seal population on the U.S. west coast. SWFC Admin. Rep., La Boveng, Peter. 1988. Status of the Pacific harbor seal population on the U.S. west coast. SWFC Admin. Rep., La Jolla, LJ-88-06, 25 p.

*Boveng, Peter.* 1988. Status of the California sea lion population on the U.S. west coast. SWFC Admin. Rep., La Jolla, LJ-88-07, 16 p.

*Herrick, Jr., Samuel, Jeffery G. Lee, and Dale Squires.* 1988. Documentation for the west coast fishing fleet cost-earnings data base. SWFC Admin. Rep., La Jolla, LJ-88-04, 16 p.

*Hewitt, Roger, Susan Jacobson, and Cynthia Meyer.* 1988. CalCOFI on-line data system, programmers manual, version 1.0. SWFC Admin. Rep., La Jolla, LJ-88-03.

*Perrin, Christina and Earl Weber.* 1988. Proceedings for raising albacore length-frequency data for the North Pacific. SWFC Admin. Rep., La Jolla, LJ-88-02.

*Pooley, S. G. (ed.).* 1988. Recommendations for a five-year scientific investigation on the marine resources and environment of the main Hawaiian Islands. SWFC Admin. Rep., Honolulu, H-88-2, 22 p.

*Pooley, S. G., and K. E. Kawamoto.* 1988. Economic report on Hawaii's commercial bottom fishery, 1986 (Economic module, bottom fish FMP). SWFC Admin. Rep., Honolulu, H-88-1, 20 p.

*Polovina, J. J., R. B. Moffitt, and R. P. Clarke.* 1988. Status of stocks of lobsters in the Northwestern Hawaiian Islands. SWFC Admin. Rep., Honolulu, H-88-3, 8 p.

*Squires, Dale.* 1988. Implications of selected limited access criteria for the Pacific coast groundfish fleet configuration. SWFC Admin. Rep., La Jolla, LJ-88-01, 21 p.

**Translation**

*Borets, L. A., and V. B. Darnitsky.* 1983. Influence of hydrodynamic processes on the fish productivity of the thalassobathyal; the sample of the Hawaiian submarine ridge. Izvestiya of the Pacific Ocean Scientific Research Institute for Fisheries and Oceanography (TINRO), Vladivostok 107:47- 55. (Engl. transl. by W. G. Van Campen, 1988, 11 p., Transl. No. 124; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822- 2396.)

*Sakai, K., H. Nagashima, and K. Kiso.* 1985. Growth and movement of artificially reared young rockfish, Sebastes schlegeli, after release in Matsushima Bay. Bull. Tohoku Reg. Fish. Res. Lab. 47:21-32. (Engl. transl. by W. G. Van Campen, 1988, 19 p., Transl. No. 125; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396.)

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